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Maritimes Region
Canadian Science Advisory Secretariat
Science Response 2013/021

REVIEW OF STRATEGIC ENVIRONMENTAL ASSESSMENT REPORTS FOR THE MISAINE BANK AND BANQEREAU BANK, AND BANQEREAU SLOPE, REGIONS OF THE SCOTIAN SHELF

Context

In January 2013, the Ecosystem Management Branch, Fisheries and Oceans Canada (DFO) in the Maritimes Region requested that DFO Maritimes Science undertake a review of two Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) draft Strategic Environmental Assessment (SEA) reports: one for the Misaine Bank and Banqereau Bank region, and one for the Banqereau Slope region of the Scotian Shelf (Stantec 2012a, Stantec 2012b). Ecosystem Management requested DFO Science advice on the reports related to the following question:

- Do the CNSOPB Strategic Environmental Assessment reports of the Misaine Bank and Banqereau Bank and Banqereau Offshore regions accurately identify ecosystem attributes and anticipated ecosystem-offshore petroleum interactions in the context of what is known about the marine ecosystem of these shelf and slope areas?

This information will be provided to the CNSOPB in order to inform their review of the draft SEA reports (all DFO comments on the SEA reports, and the CNSOPB's response to DFO's comments, will be posted to the CNSOPB public registry – see: CNSOPB Environmental Assessments). The SEA reports will be used by the CNSOPB to make decisions regarding the Call for Bids and, similarly, to inform potential bidders of the environmental context of the various proposed offshore petroleum parcels. It was requested that a response be provided by DFO Science on March 1, 2013. Given the short timeframe for review, DFO's Science Special Response Process (SSRP) was used.

This Science Response Report results from the Science Special Response Process of March 4, 2013, on the Review of the Strategic Environmental Assessment Reports for Misaine Bank and Banqereau Bank, and Banqereau Slope, Regions of the Scotian Shelf.

Background

The CNSOPB released draft SEA reports covering proposed offshore petroleum parcels located on the Misaine Bank and Banqereau Bank region, and the Banqereau Slope region, of the Nova Scotia Offshore Area with the intent to identify potential environment-offshore petroleum interactions that need to be considered in future offshore petroleum exploration and development activities in these regions. The two SEA reports complement CNSOPB SEA reports completed for the west Scotian Slope in 2011 (including its Addendum, which was completed in 2012) and the Eastern Scotian Shelf and Eastern Scotian Slope regions (Hurley 2011, DFO 2012a, DFO 2012b).

The intent of the SEA reports is to assist the CNSOPB in its determination on the potential issuance of future exploration rights within the Misaine Bank, Banqereau Bank and Banqereau Slope region of the Scotian Shelf, including general restrictive or mitigative measures that should be considered during the exploration program application and program specific environmental assessment process.

Analysis and Response

General Comments

The SEA reports are virtually identical in structure and content, and differ only in occasional isolated details related to specific geographic areas of potential biological impact. Many areas of potential biological influence/impacts are similar given that the "Project Areas" are adjacent and their associated "Study Areas" overlap considerably. The current SEA Project areas also abut the Project Areas in the CNSOPB Eastern Scotian Shelf and Slope SEA reports that have been the focus of a previous DFO review (DFO 2012b). Many comments from the previous DFO review also apply to the current draft SEA reports. It is encouraging to see that comments from previous DFO reviews have resulted in changes to the two earlier SEA reports and where appropriate, these changes have also been carried over to the two current draft SEA reports. While the draft SEA reports provide background information on many topics relevant to the eastern Scotian Shelf and offshore area, some important issues have not been adequately addressed in these documents.

A central question regarding the current SEA reports is whether they sufficiently delineate and emphasize the risks to endangered whales originating from exploration origin anthropogenic noise, especially seismic exploration where the risks appear most serious. Table 3.9 notes that the northern bottlenose whale (NBW), the North Atlantic right whale, and the blue whale are *Species at Risk Act* (SARA) Schedule 1 listed "Endangered" species known to occur in the Study Area. Since the latter two baleen species are wide-ranging, their critical habitat is not limited to the Study Area, while the first species, a beaked whale, appears to be essentially anchored to spatially-limited critical habitat within the Study Areas (Figure 1). While not minimizing the importance and risks to the other endangered whales, this report focuses on the NBW population and also Sowerby's beaked whale (SBW), a SARA-listed species of "Special Concern" that may be restricted to somewhat similar habitats as the NBW.

Of particular concern is the lack of recognition of the potential issues that may arise from oil and gas exploration and development activities in or near Shortland and Haldimand submarine canyons. These two canyons, like the nearby Gully Marine Protected Area (MPA), are ecologically important areas that support a diversity of wildlife including rare corals and whales, and they are identified as critical habitat of NBW. Given their importance to SARA-listed species, these canyons deserve more careful consideration within these SEA reports and the potential impacts oil and gas activities occurring in and around them should be more thoroughly addressed.

Beaked whale species are thought to be especially sensitive to anthropogenic noise disturbance. Though the impacts of seismic noise production on marine mammals are not well understood, there is empirical evidence that intense sounds can cause changes in behavior, and, in extreme cases, even injury and mortality. Given that so little is known about how seismic noise impacts marine mammals, including the listed beaked whale species, the SEA reports should discuss possible individual and population-level impacts of seismic noise production in greater detail. Seismic noise production from oil and gas activities has been identified as a potential threat to NBWs within the Recovery Strategy for the Scotian Shelf population. This Recovery Strategy (DFO 2010) is an important source of information on the potential impacts of oil and gas activities on the population that should be discussed within the SEA.

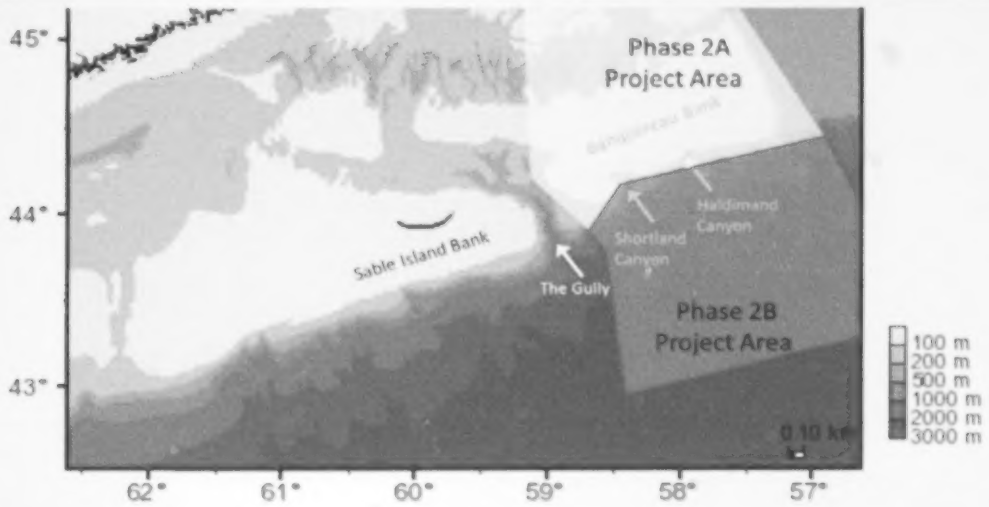

Figure 1. Approximate location of the Project Areas (Misaine Bank and Banquereau Bank is referred to as Phase 2A and Banqereau Slopes referred to as Phase 2B) in relation to The Gully, Shortland and Haldimand submarine canyons (contain Northern Bottlenose Whale critical habitat). Figure modified from DFO (2010).

There is very little information provided within the documents about the potential impacts of oil and gas activities on sea turtles. Seismic noise production has been identified as a potential threat to Endangered Leatherback Sea Turtles, and concerns around oil and gas activities for the species are discussed in the Recovery Strategy for the population (DFO 2006). The Recovery Strategy is an important source of information on the potential impacts of oil and gas activities on the population that should be discussed within the SEA.

The Statement of Canadian Practice with Respect to the Mitigation of Seismic Noise in the Marine Environment for Marine Mammals and Sea Turtles (SOCP)(DFO 2007) outlines the minimum requirements for mitigating the potential impacts of seismic exploration activities off Nova Scotia. In areas where sensitive habitats and species occur, mitigation measures beyond those provided in the SOCP need to be considered to ensure that risks are minimized.

The possible SARA implications of the potential impacts of oil and gas activities should also be more clearly outlined within the SEA reports given that Section 32 of SARA prohibits the harm, harassment, capture, kill or take of individuals, and Section 58 prohibits the destruction of critical habitat. For example, if noise produced by oil and gas activities interfered with the function of an area identified as critical habitat for a listed species (e.g., an area identified as an important foraging area) this could be considered destruction of critical habitat.

Key Characteristics of the Environment (Section 3.0)

There is no systematic discussion of acoustic propagation on the Scotian Shelf/Slope anywhere in the SEA reports although isolated facts appear in some sections of the SEA reports. Since anthropogenic sound as an environmental stressor is discussed extensively in the SEA reports, discussion of acoustic propagation effects is also warranted. Topics that could be treated, or at least acknowledged, include seasonal variability of acoustic propagation due to the spring-summer growth of the seasonal thermocline and more downward refractive high-loss conditions, and the possible facilitation of seismic sound propagation in low attenuation and near-surface sound channels in late spring/early summer. In terms of the exploration seismic-related sound energy delivered to the deep, beaked whale foraging habitats of The Gully, Shortland, and

Haldimand Canyons there could be considerable differences between fairly inefficient down-slope acoustic propagation from surveys in the shallow Misaine Bank and Banqereau Bank Project Area versus fairly efficient up-slope propagation from deep water regions of the Banqereau Slope Project Area. In the latter case, the delivery of sound to the deeper regions of The Gully would be more efficient if the survey area is situated such that sound can propagate directly up the deep central canyon axis. And even indirect propagation of seismic sounds into the Gully has occurred at levels which significantly exceeded modelled values (McQuinn and Carrier 2005). The Laurentian Channel also has its distinctive propagation environment. It is expected that such effects will be documented in detail in the acoustic modeling accompanying forthcoming survey-specific EA reports but some acknowledgement of the nature and importance of these effects belongs in the current SEA reports. Many of these issues have been documented in Davis et al. (1998), a document that is referenced in these SEA reports in other contexts.

In Table 3.1 (Overview of Physical Characteristics), wind and waves data are the same for both areas and this does not seem realistic.

Physical Characteristics (Section 3.1)

DFO has developed the Benthic Boundary Layer Transport (BBLT) model that can be used to estimate the fate of drilling waste in areas of active drilling and the exposure of such wastes on the seabed (Hannah et al. 2006). There should be some mention of the existence and capability of this model in the SEA reports.

Biological Characteristics (Section 3.2)

Mysticetes and Odontocetes (Section 3.2.5.1)

While the Trans North Atlantic Sightings Survey (TNASS) provides a large-scale overview of various cetacean species of the Scotian Shelf, the results from this survey are based on about one month of effort in July/August 2007 and, thus, cannot be used to determine cetacean distribution and abundance in non-summer months, or natural variability in the trends observed. Finer scale abundance and distribution patterns for some species of particular interest can be obtained from species-specific research programs, such as H. Whitehead's (Dalhousie University) work on Scotian Shelf NBWs. Some additional references that would be relevant and useful for this section are Breeze et al. (2002), which provides a comprehensive review of cetacean species of the Scotian Shelf and likely preferred habitat based on analysis of several available datasets, and Whitehead (2013), a recent paper looking at whale densities in the Gully, Shortland, and Haldimand canyons.

Though the focal point of the distribution of NBWs is around the Gully and nearby Shortland and Haldimand canyons, there is evidence that the shelf-break areas between these canyons are also important feeding areas (Moors 2012). This more recent acoustic monitoring study indicates that NBWs feed year-round not just in the Gully, but also in Shortland and Haldimand canyons, as well as between the canyons. These whales are, thus, considered to be year-round residents of the Scotian Slope including canyon and between canyon areas. The likely importance of between-canyon areas should also be considered.

There are also a number of NBW sightings reported along the continental slope in areas west of the Gully (see Figure 2 in the NBW Recovery Strategy)(DFO 2010). Because of the lack of research effort in areas to the west of the Gully, it is hard to gauge the importance of these areas to the whales. The Recovery Strategy recognizes that the distribution of the whales does extend west of the Gully and the need to investigate canyons west of the Gully (such as Logan canyon) as potential critical habitat for the whales. There should be some acknowledgement

that the distribution of these whales does extend west of the Gully, along the entirety of the Scotian Slope and even as far south of Georges Bank (DFO 2010, NMFS 2007).

Additional cetacean sightings data is available through DFO and can be provided upon request (contact: Lei Harris, DFO).

Table 3.9 should include additional information on the distribution of some of the species. For example, long-finned pilot whales occur on the Scotian Shelf throughout the year, not just late spring through fall. Humpback whales are regularly sighted over most areas of the shelf and not just in the Gully. There have been a number of blue whale sightings in the Gully in late summer. As well, SBWs are listed as Special Concern by COSEWIC, as well as SARA.

Sea Turtles (Section 3.2.5.3)

Very little information is provided on sea turtles and there are important areas for leatherbacks in the project area that should be recognized in the SEA reports (DFO 2011). A map of sea turtle sightings and these important areas should be provided. Also, in Table 3.11, the leatherback sea turtle should be listed as endangered under SARA.

Socio-economic Characteristics (Section 3.3)

Other Ocean Uses Section (Section 3.3.4)

In Table 3.26 there are other scientific research projects within the study areas beyond those listed, including cetacean studies conducted by the H. Whitehead Lab of Dalhousie University every 3-4 years, and ongoing long-term acoustic monitoring studies in the Eastern Scotian Slope region (contact: Hilary Moors-Murphy, DFO).

Selection of Valued Environmental Components (Section 4.5)

It is highly recommend that the following statement be omitted from Table 4.3:

> "No further assessment will be provided required that: The proponent adheres to mitigation measures outlined in the Statement of Canadian Practice with Respect to the Mitigation of Seismic Noise in the Marine Environment for marine mammals and sea turtles."

The SOCP provides the minimum requirements for seismic activities and although it represents an important mitigation measure, the SOCP mostly consists of operational measures and procedures to prevent immediate physical harm to marine mammals (airgun ramp-ups and safety, radii etc.). While the SOCP does contain a survey planning component, there is no explanation of whether or what measures will be implemented to mitigate any possible behavioural effects of seismic sound propagating beyond the 500 m standard safe radii. The impression from the draft SEA reports is that only the standard operational measures are being considered and the existing knowledge base is insufficient to do more. For several reasons, the SOCP is inadequate for beaked whale species such as NBWs and SBWs, and more should be done in and around areas known to be regularly used by beaked whales. For example, the 30 minute required observation period is shorter than the maximum dive time of these species. Scotian Shelf NBWs commonly dive for over thirty minutes, with maximum recorded dive time of 70 minutes reported (Hooker and Baird 1999). The observation period should be increased substantially (at least 60-70 minutes) when conducting activities in beaked whale habitat. It is also known that these cryptic, deep-diving species tend to dive collectively as a pod or groupings and are generally very difficult to spot even by well-experienced and trained observers because they spend so little time at the surface and their respirations are not highly visible. Even in the best of circumstances, using experienced observers and during good weather conditions, the probability of visually detecting beaked whales even when they are

present and near the vessel is in the range of 20-50%, at best (Barlow and Gisiner 2006). This probability decreases substantially with inexperienced observers and as sea state increases and visibility decreases (e.g., rain, fog, reduced light levels). Under these conditions the probability of sighting a beaked whale is estimated to decrease to as little as 1-2% (Barlow and Gisiner 2006). Another important factor to consider in developing appropriate mitigation is that when beaked whales, such as NBWs, undergo deep dives they often do so to forage and frequently produce distinctive echolocation clicks (Hooker and Baird 1999, Moors 2012). Thus, a combination of passive acoustic monitoring (PAM) and visual observation would likely provide the greatest probability of detecting NBWs present within the study area (Moors 2012). PAM is not currently required under the SOCP.

Species of Special Status (Section 5.1)

Seismic and Seabed Surveys (Section 5.1.1.1)

Physiological and Behavioral Effects on Marine Mammals

In general, this section needs to be more thorough. Some relevant references not currently included in the SEA are provided in the Scotian Shelf NBW Recovery Strategy (DFO 2010).

The fifth paragraph in Section 5.1 (Species of Special Status 5.1.1.1 Seismic and Seabed Surveys – Physiological and Behavioural Effects on Marine Mammals), while conveying some valid concerns for NBW and SBW, tends to underplay or obscure real risks, which may include alterations in diving and foraging behaviours. The multi-month duration of typical modern seismic surveys could place these species under stress on a spatially widespread or population-level basis (more applicable to NBW). In the worst case scenario, these exploratory activities could evoke more acute physiological effects for these beaked whales from gas exchange problems arising from shallow repetitive dive patterns (Zimmer andTyack 2007).

The potential impacts of vocalization masking are important and should be discussed in more detail given that seismic surveys can occur over long time periods (weeks to months). Changes in behaviour such as area avoidance may not as important over very short time scales (hours-days), but, over long time scales, such changes in behaviour have the potential to cause population-level impacts. The population-level effects of the behavioural changes of individuals that were discussed (e.g., evidence of avoidance of seismic arrays and reduction in vocalization rates noted during Marathon and Encana seismic surveys) or other potential impacts such as masking, when such impacts occur over long time scales (weeks-months) needs to be considered.

The reason there is such great concern about the potential effects of seismic on beaked whales, including NBWs and SBWs, is that these types of whales appear to be particularly sensitive to underwater sound. There has been clear scientific evidence of beaked whales strandings caused by intense anthropogenic noise (such as military sonar), so intense sounds in general, including seismic noise, are of concern. This section should highlight the concerns around beaked whales and intense noise, especially as the study area encompasses known habitat of an endangered beaked whale population, and oil and gas activities has been identified as a threat to the Scotian Shelf NBW population (DFO 2010).

The SEA reports do call attention to the fact that there have been no documented cases of marine mammal mortality or injuries as a consequence of seismic surveys, including the 2005 Marathon and Encana surveys that were conducted in or close to these Study Areas. While the associated study results presented in Lee et al. (2005) provide some information on species presence and behavior during seismic surveys, data on cetacean presence and behaviour was not collected before the seismic vessels were present in the study area or after they left, thus proper comparisons of cetacean behavior before, during and after seismic operations could not

be made. Also the studies reported in Lee et al. (2005) may not show indications of significant effects merely because they were not designed to detect more subtle behavioural and foraging effects that might, for instance, now be monitored by electronic tags The SEA reports do indicate possible impacts but the conclusions are conservative and based on the results of extremely limited data regarding the response of beaked and other toothed whales to seismic sound. These caveats should be better explained in the SEA reports as this may affect the conclusions that one may draw from the statement that there was no indications that whale species were significantly affected by the 2003 seismic programs. This is especially true given that within the remote areas of the Scotian Shelf/Slope, substantial harm or mortality to NBWs might not be readily detectable (or have been detected in the past) unless the damage impacts (or impacted) a substantial fraction of the total population. Overall, little is known about the behavioural responses and sensitivities of endangered NBW's to seismic sound, yet the SEA reports consider seismic profiling very close to, and possibly even through NBW critical habitat. Therefore, under these circumstances, appropriate precaution is warranted and the SEA reports should draw sufficient attention to potential risks of these types of proposed activities arising from existing knowledge gaps.

Although Davis et al. (1998) concluded the zone of behavioral effect on the Scotian Shelf for odontocetes may be approximately 1 km in radius, caution is warranted when making inferences about a zone of behavioural effects based on a previous SEA rather than on more recent scientific literature; there has been advancement in knowledge about behavioural effects since 1998, thus a review of the current scientific literature, as well as modelling studies would provide a more accurate idea of the range at which seismic sound production may impact marine mammals.

This section discusses potential effects of seismic activities on squid and suggests that seismic sound production may cause squid to avoid an area. If this were to occur in designated critical habitat of NBW (Shortland and Haldimand Canyons), particularly over a prolonged period, it could be considered destruction of critical habitat and, thus, be in violation of the SARA. As well, disturbance of listed individuals is also prohibited by the SARA. These SARA implications need to be addressed here or elsewhere.

Exploratory Drilling (Section 5.1.1.2)

Continuous noise generated by drilling activity could potentially have physiological and behavioral effects on marine mammals. For example, drilling may potentially disturb marine mammals, mask their vocalizations, or cause avoidance of an area. The potential effects of drilling activities on marine mammals are not thoroughly discussed.

Explanations and reference should be provided that clarify the use of 0.5-1 km as the expected extent of spatial avoidance by marine mammals. Caution is warranted in using older SEA reports, such as Davis et al. (1998), to make statements like, "the effects of drilling noise on marine mammals of special status is considered to be temporary and reversible", and it is suggested that references from more recent primary scientific literature be used to support such strong statements.

Species of special status are lumped together, though potential impacts will likely vary considerably between species. For example, some listed whale species are highly migratory (such as blue whales) and may be able to search for food elsewhere if forced to avoid feeding in an area where drilling is occurring. NBWs, on the other hand, are year-round residents of a relatively small areas, and have a relatively restricted home range. If they are forced to avoid prime foraging habitat (or habitat needed for other important life functions such as mating and rearing young) for an extended period, they may have nowhere else to go to perform these

important life functions and, thus, prolonged avoidance of an area could potentially have significant population-level impacts.

Acoustic modelling has advanced considerably since the 2003 Marathon Scotian Shelf survey and it now appears possible to fairly accurately compute acoustic levels at various safety radii (100s of meters) as well as to display isolines of acoustic levels at extended ranges (10s of kilometers) from airgun arrays while incorporating the effects of 3-D bottom bathymetry, SEA reports on water column characteristics, and the detailed structure of the source arrays. Additional consideration needs to be given to how these more reliable survey-specific acoustic exposures predictions can be used to adequately protect marine mammals while at the same time not unduly compromising industry's field programs to exploit a resource. Despite improvements in sound propagation modelling, errors and surprises still occur so proponents are encouraged to incorporate field sound measurements into their monitoring and mitigation frameworks.

Vessel Traffic (Section 5.1.1.3)

Increases levels of vessel noise and potential masking is an important impact of increased vessel traffic on marine mammals. This should be addressed in this section.

Well Abandonment (Section 5.1.1.4)

The mitigation measures for marine mammals and sea turtles are not explained adequately. Specifically, it is unclear why a 1 km buffer distance from blast locations is proposed given that there does not appear to be any scientific literature referenced that supports this buffer. Also, a better explanation should be provided on how long a site will be monitoring prior to blasting to ensure no marine mammals or turtles are in the area, considering that these animals can spend very long times at depth.

Accidental Spills (Section 5.1.1.5)

Accidental spills, particularly a wellhead blowout, have the potential to cause significant and long-term environmental impacts. The potential population-level impacts of such incidents, particularly on listed species, should be discussed. Mitigation of these potential impacts, particularly what is be expected of oil and gas companies in term of mitigation and response, should also be discussed.

With respect to Tables 5.1, 5.3, 7.1, 8.1, and 9.1, measures beyond the SOCP may be required for seismic activities. As well, multiple trained marine mammal observers are particularly important to help collect sightings data during long-term seismic exploration operations; however, as identified above, it is suggested that this mitigation measure include a requirement that the marine mammal observers be experienced in identifying beaked whales.

Data Gaps and Uncertainties (Section 5.1.3)

The SEA reports acknowledge critical knowledge gaps such as data on potential effects of seismic on beaked whales (e.g., NBW and SBW). However, the remainder of this subsection is weak and non-incisive with "motherhood" statements such as, "Continued research and wildlife monitoring during oil and gas activities may further knowledge in this area, particularly if monitoring surveys are standardized and data is shared for future use." (paragraph 2). It should be clearly articulated in the SEA reports that it is not known how seismic sound influences NBWs until the relevant experiments are done, and the most relevant experiments will be ones in which NBWs are closely monitored while exposed to actual seismic sound. In other words, any forthcoming seismic surveys on the eastern Scotian Shelf would present a research opportunity to fill knowledge gaps. The draft SEA reports provide an opportunity to encourage industry support and cooperation for ongoing research on this topic. This is also true in the

Summary Section 8.0 (Data Gaps and Recommendations) which is again quite vague in stressing research opportunities and states that studies are underway to address sound source characterization and propagation; physical and physiological effects and hearing; behavioural reactions and biologically significant effects; and mitigation and monitoring. While current studies may well be of value, given the significant data gaps and uncertainties documented throughout this review, a more proactive and focused monitoring and mitigation approach must be advocated.

Special Areas (Section 5.2)

In regard to the acoustic effects of seismic surveys, and to a lesser degree, exploration drilling, vessel traffic, and well abandonment activities, a number of "Special Areas Potentially Affected" are listed in Table 5.2 (both SEA reports). The Gully MPA and Shortland and Haldimand canyons are all (correctly) listed in Table 5.2. with regards to the NBW and SBW. Shortland and Haldimand canyons should also be included in the list of special areas as they are also being considered for exploratory drilling. No connecting corridor between the Gully and the two easterly canyons is listed as a potentially affected "Special Area" even though it is known that the NBW populations exchange between these recognized NBW critical habitats.

Table 5.2 (both SEA reports) lists "Special Areas and Ecological Features Potentially Affected by Oil and Gas Activities". The Gully MPA is excluded from the Project Areas by MPA legislation banning exploration within their boundaries, but it is included in the expanded "Study Areas" (areas potentially impacted by exploration activities conducted within the "Project Areas"). Neither Shortland nor Haldimand canyons are excluded from seismic exploration activities; however, it is acknowledged in Section 5.2 (Special Areas) that:

> "... a higher degree of caution and enhanced mitigation should be exercised in Special Areas that have been recognized through formal designations as areas with specific management measures: the Gully MPA, Sable Island National Park Reserve, Shortland canyon (along with Haldimand canyon as Northern bottlenose whale Critical Habitat), as well as St Anns Bank and Laurentian Channel AOI's" (third paragraph).

If special areas such as Haldimand and Shortland canyons require a higher degree of caution than it is suggested that future survey-specific EA reports must thoroughly assess their specific environmental sensitivities.

Fisheries (Section 5.3)

It is encouraging to see the inclusion of information on the "Behavioural Effects of Fisheries Resources Affecting Catchability" in which a number of case studies are cited reporting correlations between seismic exploration operations and the subsequent catchability of fish. In isolation, these studies have been controversial since cause and effect relationships are difficult to establish with confidence. Nevertheless, the accumulating evidence is more compelling and such effects should be taken seriously given the potential economic implications for the fishing industry even if the underlying biological effects might be reversible.

Cumulative Effects (Section 7.0)

In regard to acoustically-related cumulative stress or low level behavioural impacts on beaked whales or other species "anchored" to limited geographical areas, the timing of surveys in adjacent Project Areas could be quite important. In the context of risk to vulnerable populations, the SEA reports should discuss the trade-offs for SARA-listed species associated with seismic surveys occurring one after another in closely-spaced Project Areas without significant time intervals versus two surveys occurring simultaneously in closely-spaced Project Areas.

Conclusions

The SEA reports are virtually identical in structure and content, and differ only in occasional isolated details related to specific geographic areas of potential biological impact. It is encouraging to see that comments from previous DFO reviews have resulted in changes to the two earlier SEA reports and, where appropriate, these changes have also been carried over to the two current draft SEA reports. While the draft SEA reports provide background information on many topics relevant to the eastern Scotian Shelf and offshore area, some important issues have not been adequately addressed in these documents.

A central question regarding the current SEA reports is whether they sufficiently delineate and emphasize the risks to endangered whales originating from exploration origin anthropogenic noise, especially seismic surveys, where the risks appear most serious.

Given that the area included in these SEA reports encompasses habitat regularly used by several SARA-listed marine mammals that are thought to be especially sensitive to anthropogenic noise disturbance, additional discussion and analysis is warranted in relation to potential impacts of seismic noise production and other oil and gas activities on these species.

Of particular concern is the lack of recognition of the potential issues that may arise from oil and gas exploration and development activities in or near known NBW critical habitat in Shortland and Haldimand submarine canyons.

While the SOCP outlines the minimum requirements for mitigating the potential impacts of seismic exploration activities off Nova Scotia, in areas where sensitive habitats and species occur, mitigation measures beyond those provided in the SOCP need to be considered to ensure that risks are minimized. Although PAM is not currently required under the SOCP, a combination of PAM and visual observation would likely provide the greatest probability of detecting NBWs present within the study area.

There is very little information provided within the documents about the potential impacts of oil and gas activities on endangered leatherback sea turtles and, given than seismic noise production has been identified as a potential threat in the Recovery Strategy for this population, additional discussion and analysis is warranted in relation to potential impacts on this species.

There is no systematic discussion of acoustic propagation on the Scotian Shelf/Slope anywhere in the SEA reports, although isolated facts appear in some sections of the SEA reports. Since anthropogenic sound as an environmental stressor is extensively discussed in the SEA reports, discussion of acoustic propagation effects is warranted.

Additional consideration needs to be given to how recent advancements in survey-specific acoustic exposures predictions can be used to adequately protect marine mammals while at the same time not unduly compromising industry's field programmes to exploit a resource. The SEAs should also consider the multiple cases in Canada where predictions and subsequent measurements of seismic sound propagation have differed significantly. In the case of the Gully area or other important habitats for SARA-listed species, and during the first few operations, the proponents should conduct field measurements to ascertain the veracity of their acoustic propagation models.

The SEA reports acknowledge critical knowledge gaps associated with the potential effects of seismic sounds on beaked whales (e.g., NBW and SBW) and should emphasize the need for industry support and cooperation for ongoing research to fill knowledge and data gaps on this topic.

Contributors

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Sources of Information

This Science Response Report results from the Science Special Response Process of March 4, 2013, on the Review of the Strategic Environmental Assessment Reports for Misaine Bank and Banqereau Bank, and Banqereau Slope, Regions of the Scotian Shelf.

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